Applying Software Architecture Principles in a DoD Acquisition

Software in Acquisition Workshop
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Presentation Overview

Brief background of the Common Link Integration Processing (CLIP) program

Discuss software architecture principles and approach used to support CLIP's goals and objectives in the acquisition

Lessons learned and resulting program impacts from applying software architecture guidelines in the acquisition
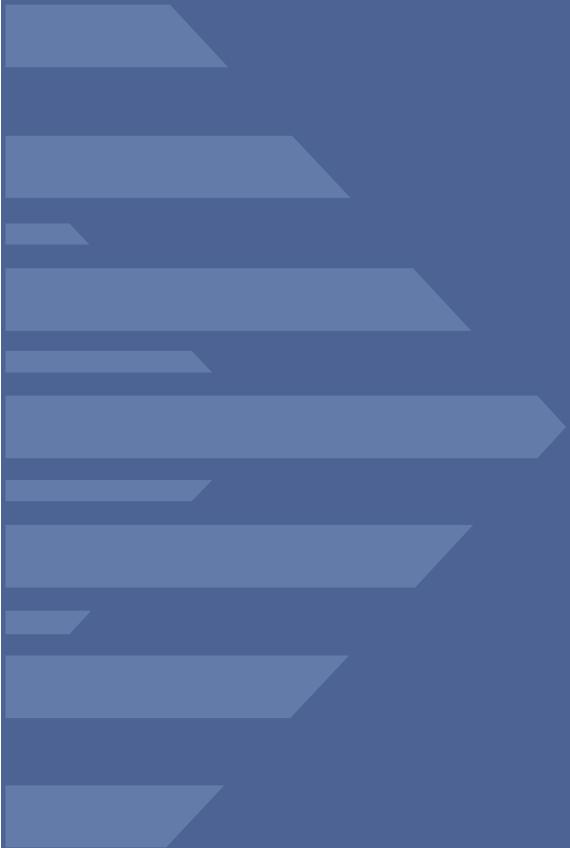
CLIP Program Background

CLIP Background

Cooperative Navy and Air Force program to develop common tactical data link (TDL) message processing software for air, ship, and shore platforms

Provides non-invasive TDL functionality for TDL-disadvantaged platforms

Facilitates communications between TDLs and IP-based communications to enable Network Centric Warfare

Developed in 4 increments with increasing message processing and host platform interfaces

Open, layered architecture design is Software Communication Architecture (SCA) compliant and can be hosted on multiple computing environments

CLIP Business Drivers and Goals

Provide common communication software and platform interface that are data link independent

Insulate host platform from changes to terminal/radio and TDL standards

Enhance interoperability

Lower cost and faster time to fielding

Architecture-centric development to achieve key system qualities

Software product line approach to enable strategic software reuse
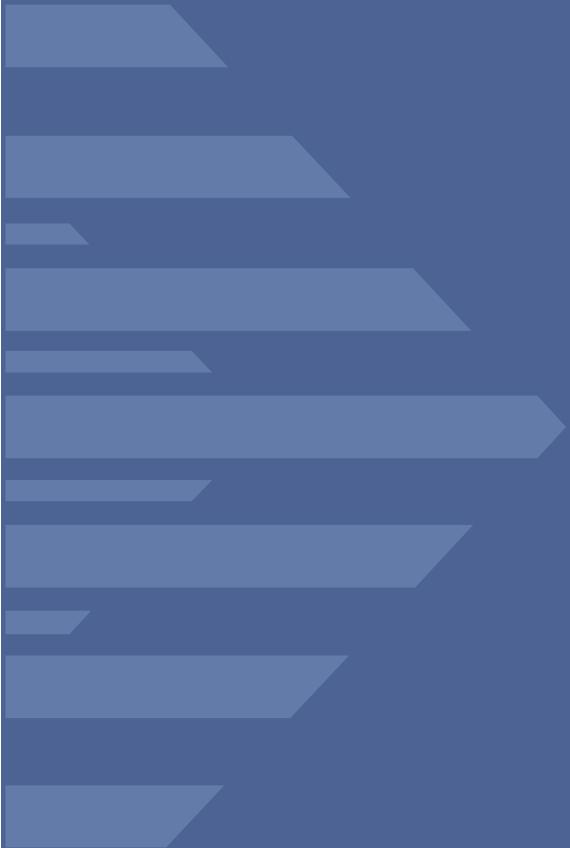
Software Architecture Principles and Approach Used for CLIP

Software Architecture in Acquisition

There are many reasons to focus on software architecture during an acquisition

- Provides early visibility into key design decisions and constraints that drive cost and schedule of entire software development effort

- Provides a framework to identify and mitigate risks

- Provides a link to business drivers

- Provides visibility needed to optimize/guide use of limited program resources

Software architecture techniques can be used throughout the acquisition cycle

- Realize more benefits by being proactive and starting early (pre-RFP)

- Focus should be on an **architecture-centric acquisition** approach

The Cone of Uncertainty
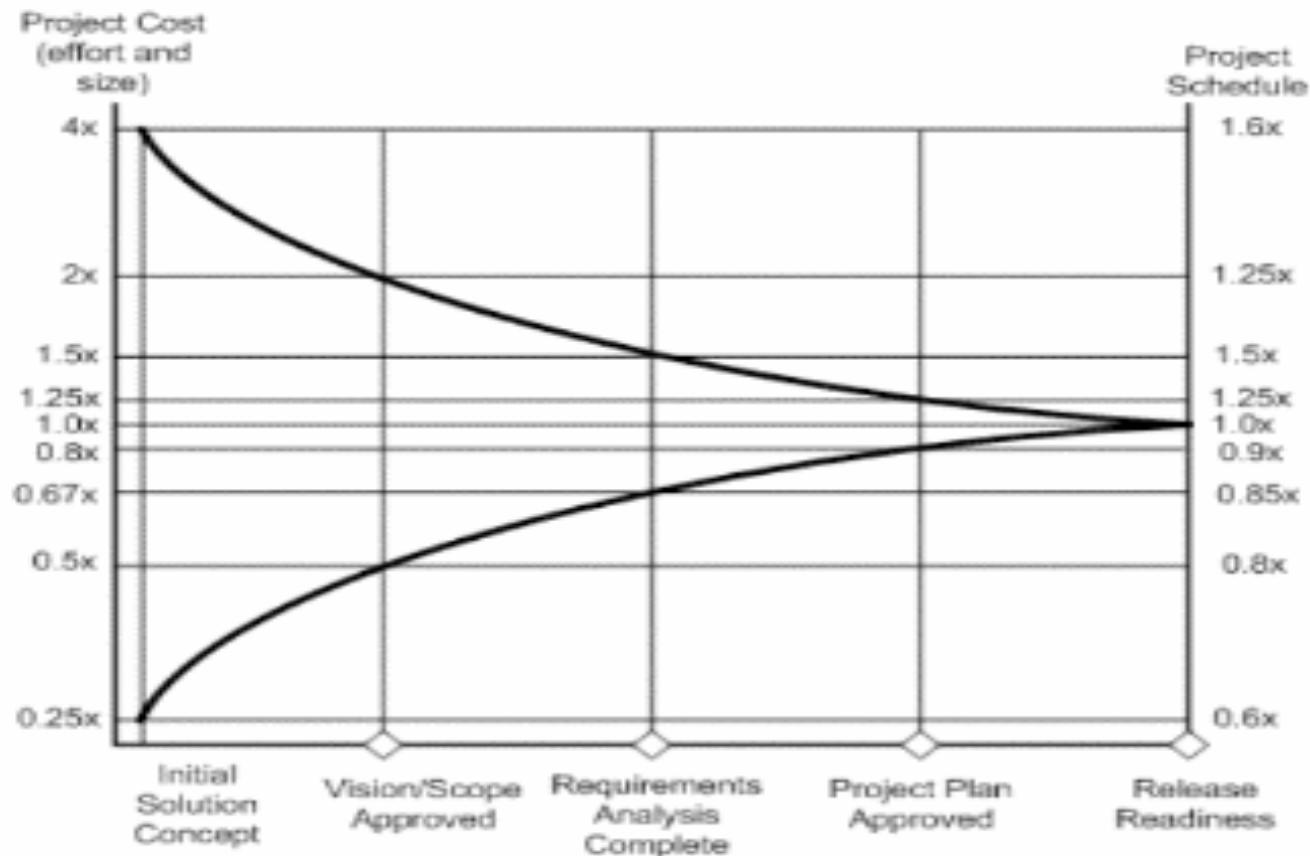
http://en.wikipedia.org/wiki/Cone_of_Uncertainty

Software Architecture Principles

Focus on software quality attributes

- Stakeholders discussing, clarifying, and prioritizing non-functional requirements

Realization that Software Architecture is Key

- Embodies the early design decisions that addresses the quality attributes

Evaluation of the Software Architecture

- Provides early risk reduction

Documentation of the Architecture

- Provide a common structure for software designers to develop from

Risk Management

- Risk identification and reduction

Training

- Educate both program office and contract personnel

Architecture-centric Approach

Pre-Contract planning

- Development of a CLIP acquisition timeline

- DoD 5000 Acquisition Documents for Milestone B

- CDRL definition

Contract technical monitoring

- Evaluation/Appraisal techniques

- Risk management

- CDRL review
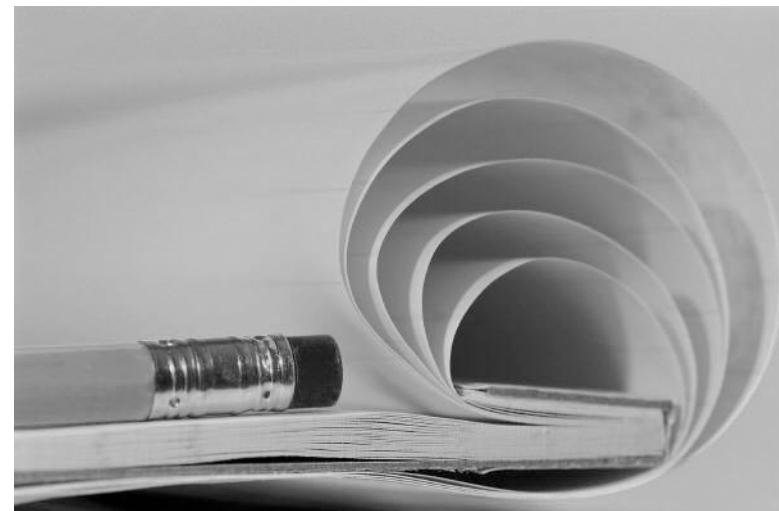
SEI Techniques Used

Acquisition Planning Workshop (APW): A structured forum for key acquisition stakeholders to understand a program's acquisition approach and current status, and proactively explore potential ways for reducing acquisition risk via a facilitated technical interchange.

Quality Attributes Workshop (QAW): A facilitated method for engaging system stakeholders early in the lifecycle, to discover the business and mission drivers and system quality attributes that drive the system and software architectural design.

Architecture Tradeoff Analysis Method (ATAM®): A method for conducting a collaborative evaluation to assess the consequences of architectural decisions in light of quality attribute requirements and business and mission goals.

Software Architecture Training

Development of a CLIP Acquisition Timeline
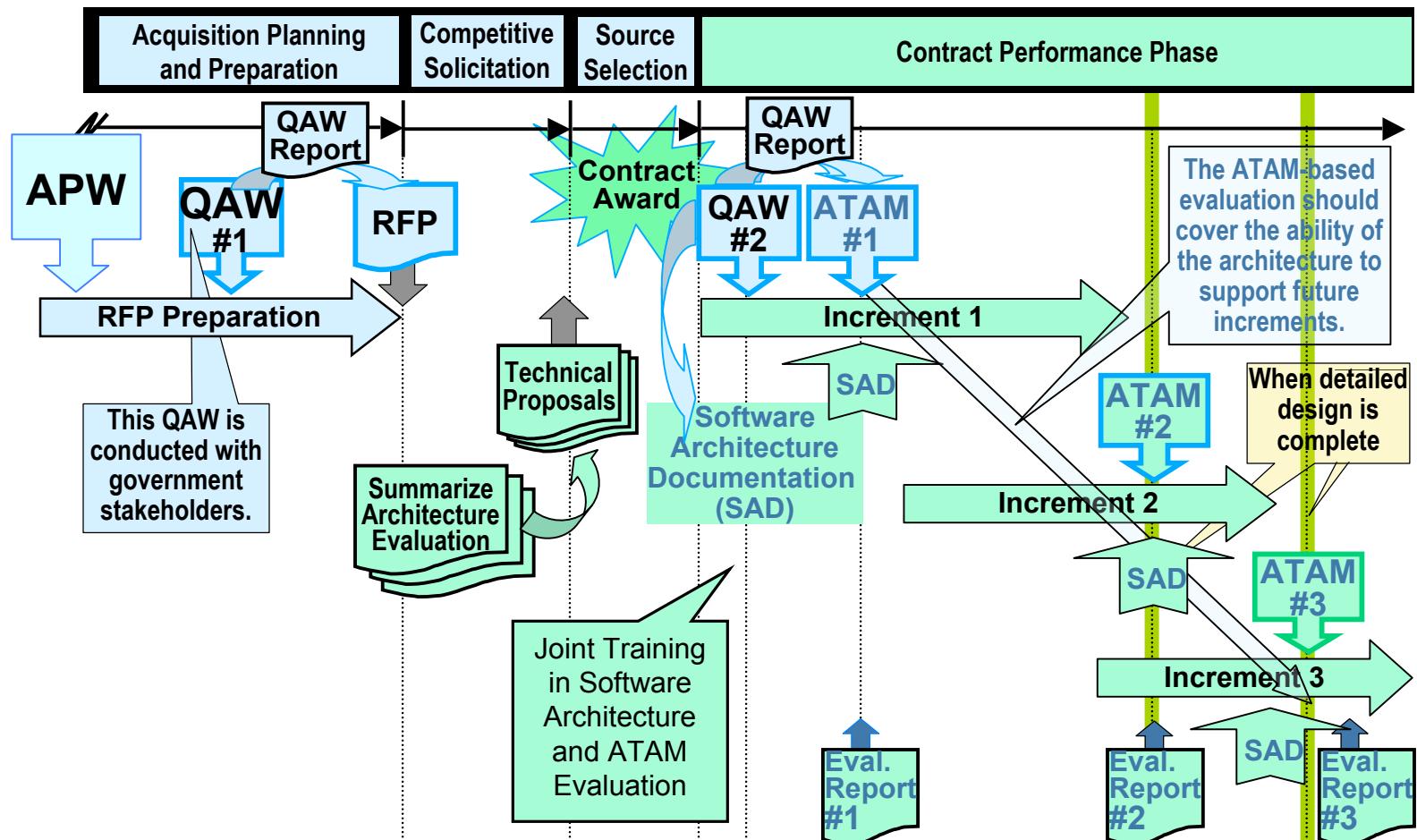
Overview of Acquisition Planning Workshop

Understand ➡ **Elicit** ➡ **Explore** ➡ **Focus**
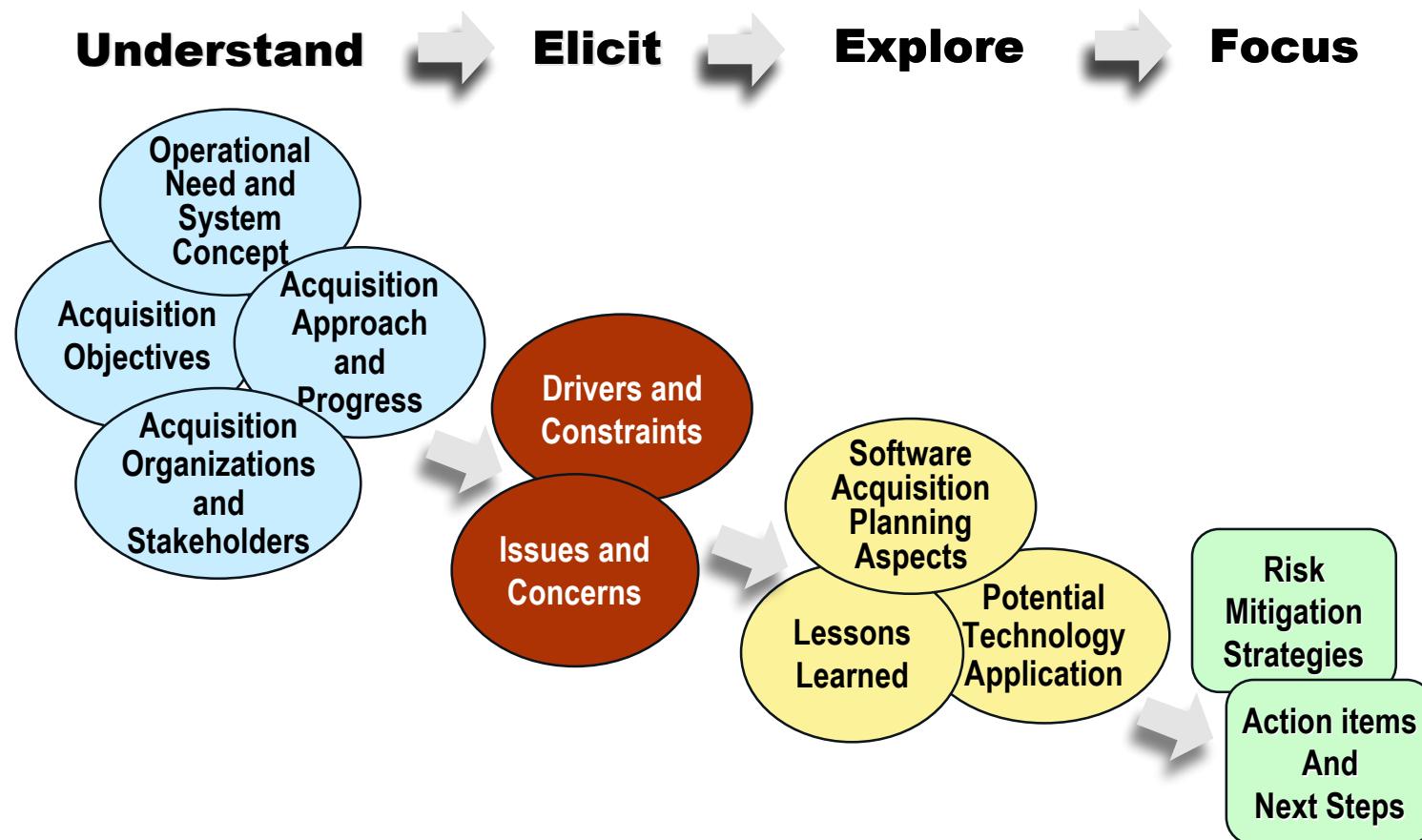
Pre-RFP QAW

Opportunity for government acquisition stakeholders to meet face-to-face

Forum to stimulate development and refinement of requirements (functional and non-functional)

Gain stakeholder buy-in of system being acquired and its quality attributes

Outputs were used to

- Refine a previously developed concept for the CLIP architecture
- Identify requirement areas that needed additional work
- Develop technical evaluation questions and criteria for the RFP

Key DoD 5000 Acquisition Documents

Acquisition Strategy/Plan (AS/AP)

Test and Evaluation Master Plan (TEMP)

Source Selection Plan (SSP)

System Engineering Plan (SEP)

Request for Proposal (RFP)

Request for Proposal - 1

Statement of Work (SOW)

- IEEE/EIA 12207 Software Life Cycle Processes

- Capability Maturity Model Integration (CMMI)

- Quality Attribute Workshop (QAW)

- Architecture Tradeoff Analysis Method (ATAM)

System Requirements Document (SRD)

- Identification of quality attributes

- Specification of a reference architecture

Request for Proposal - 2

Section B

- Identified program milestones and associated exit criteria with ties to award fee

Sections L and M

- Program Management Plan (PMP), Integrated Master Schedule (IMS), Risk Management Plan (RMP)

CDRL Definition

IEEE/EIA 12207 Software Life Cycle Processes

Process implementation

System Requirements Analysis

System Architectural Design

Software Requirements Analysis

Software Architecture Design

Software Detailed Design

Software Coding and Testing

Software Integration

Software Qualification Testing

System Integration

System Qualification Testing

Software Installation

Software Acceptance Support
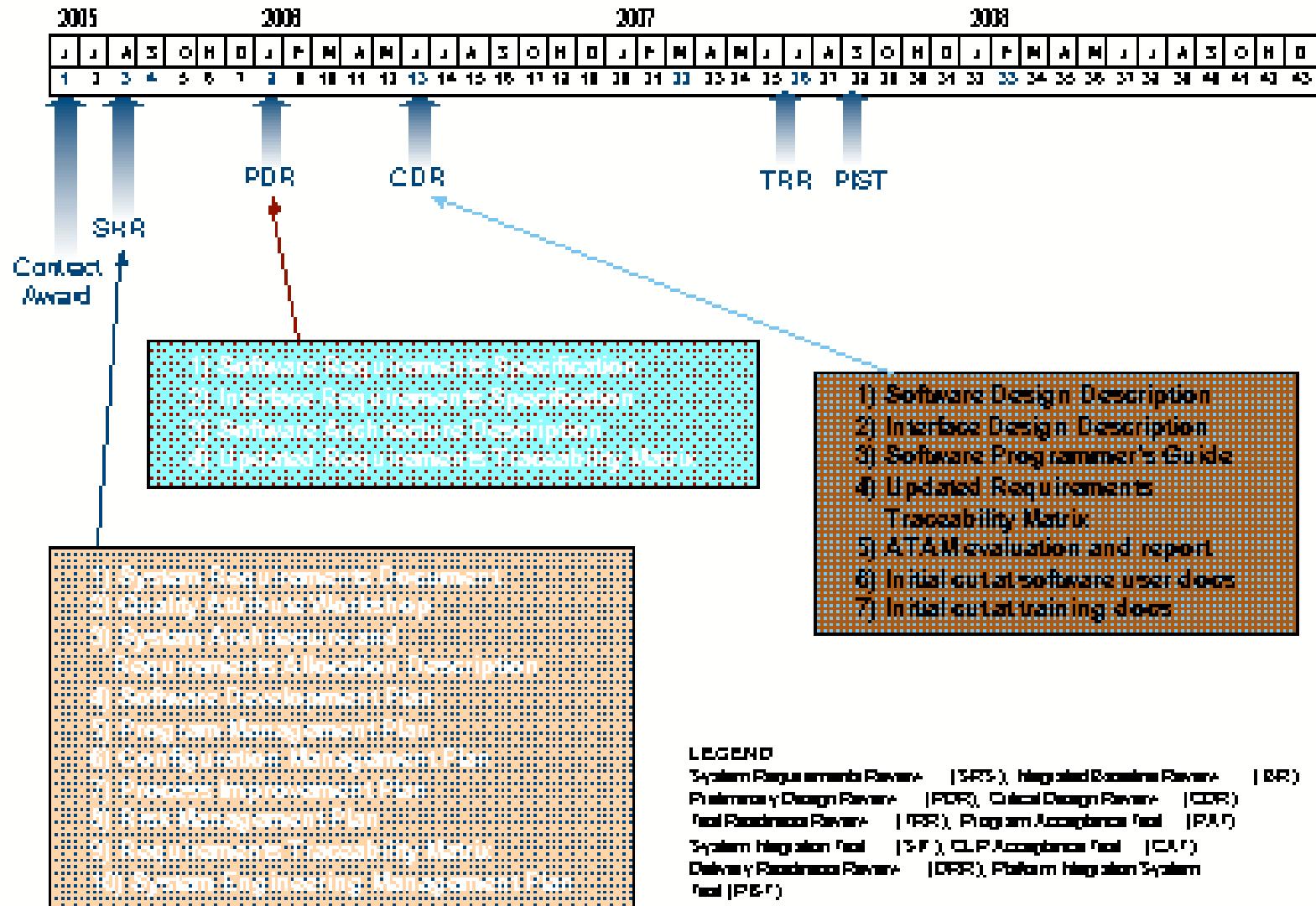
CLIP Timeline for Key Documents

Contract Monitoring Activities

Risk Management Plan

Joint training

Quality Attribute Workshop

CDRL delivery and review

Architecture Tradeoff Analysis Method

Development of a CLIP Acquisition Timeline
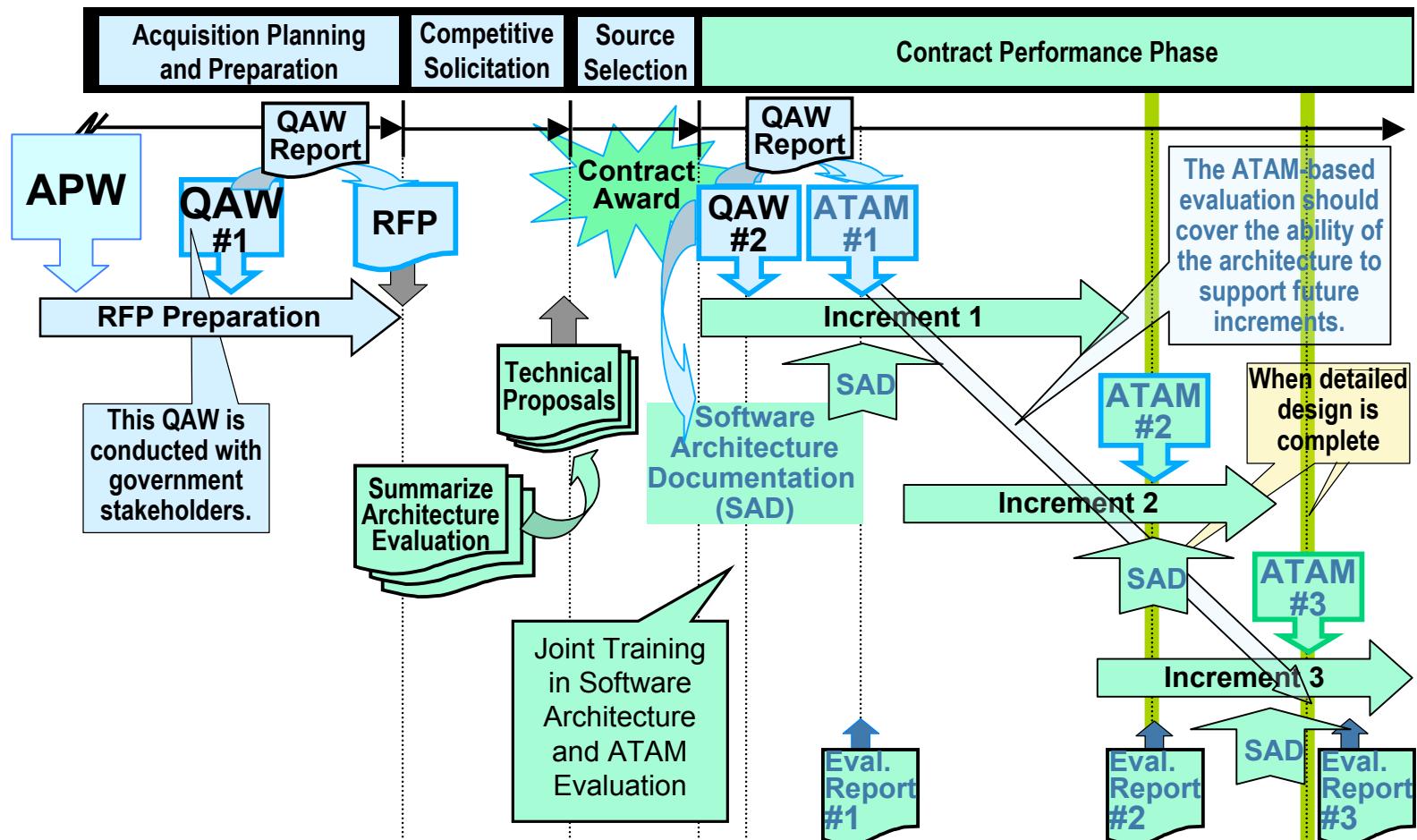
Risk Management

The Risk Management Plan was the first CDRL submitted and signed off on because of its importance to the program

Joint risk management process

Monthly Risk Review Boards

Open communication (**risk** is not a 4-letter word)

Provides the forum to identify, gain agreement on, and implement mitigation strategies to address (architecture) risks

Value to the program by providing visibility to other program offices and senior management

Post-contract Award QAW

Helped to gain a shared vision of what CLIP was to be

Stimulated refinement of requirements (functional and non-functional) provided in the SOW and the SRD

Helped stakeholders to better understand the roles and responsibilities of the IPTs which had been formed

Facilitated communications between the teams

Prioritized outputs were used as a basis to make decisions in the software architecture and design documentation

CDRL Delivery and Review

Delivery aspects of CDRLs

- Frequency

- Date of First Submission

- Date of Subsequent Submission are filled in

Ability of the program office to support the reviews

How are communications between CDRL developers and the associated program office IPT representatives?

The review process was revised between PDR and CDR milestones to improve the process to make sure the content of the documents satisfied the expectations of both sides

Conceptual Flow of ATAM
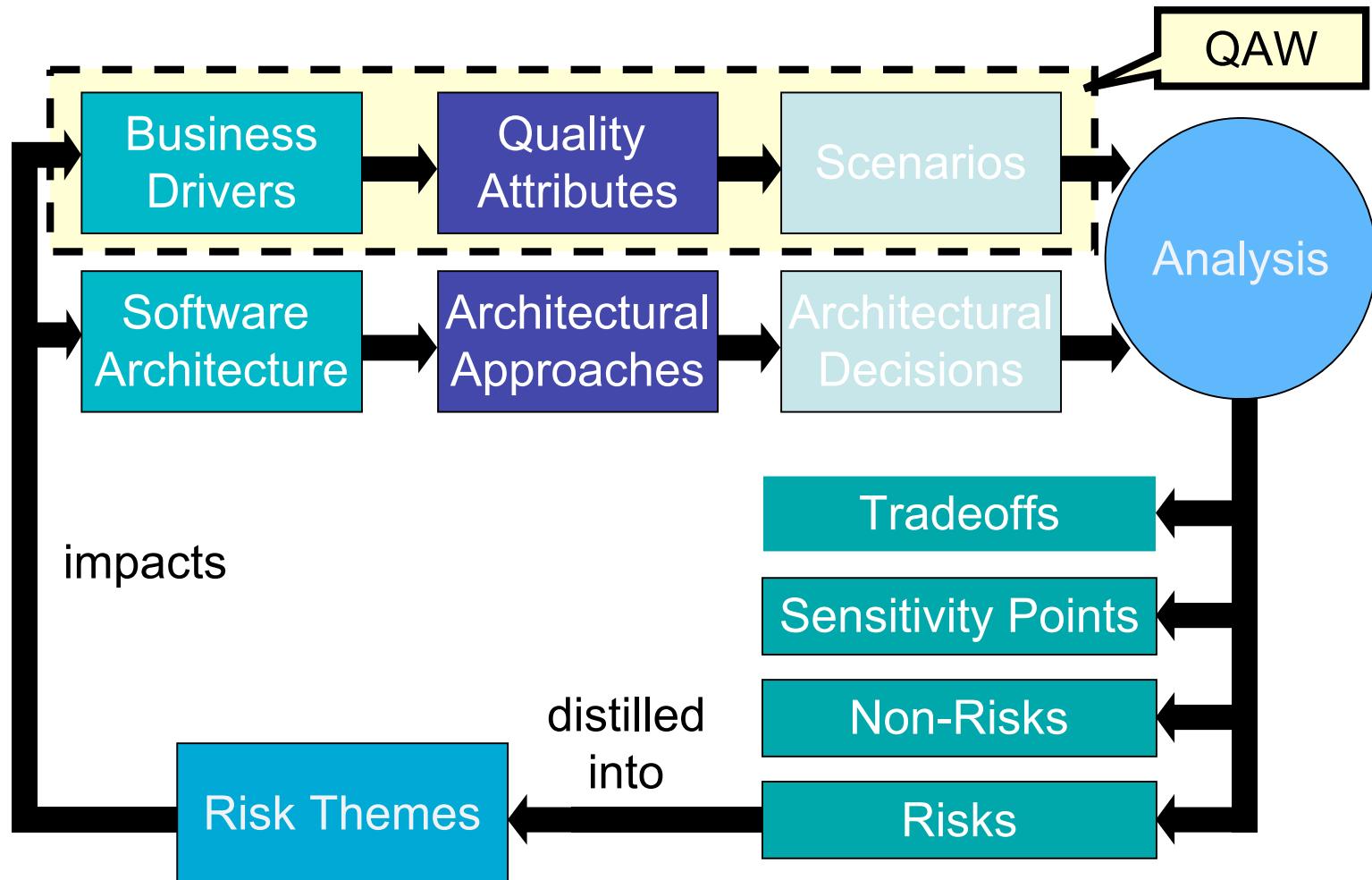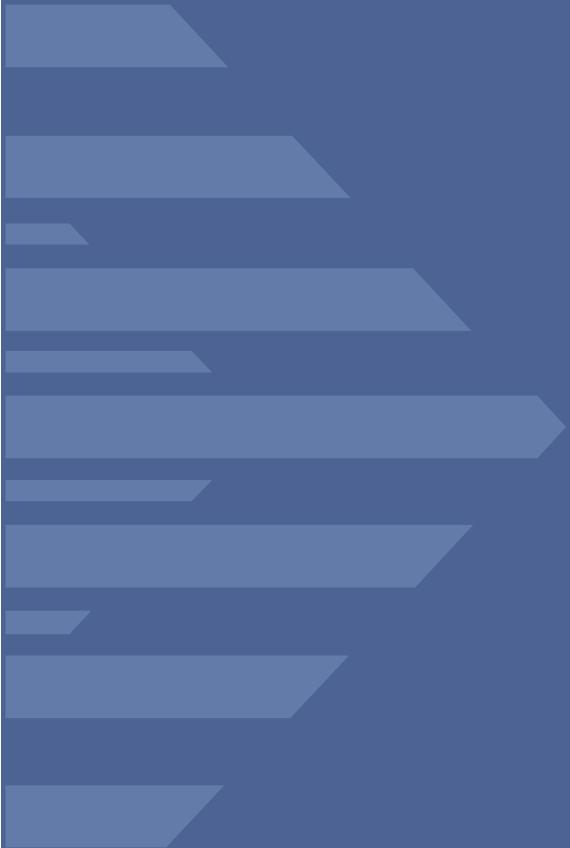
Lessons Learned and Resulting Program Impacts

Software Architecture in the Acquisition Life Cycle
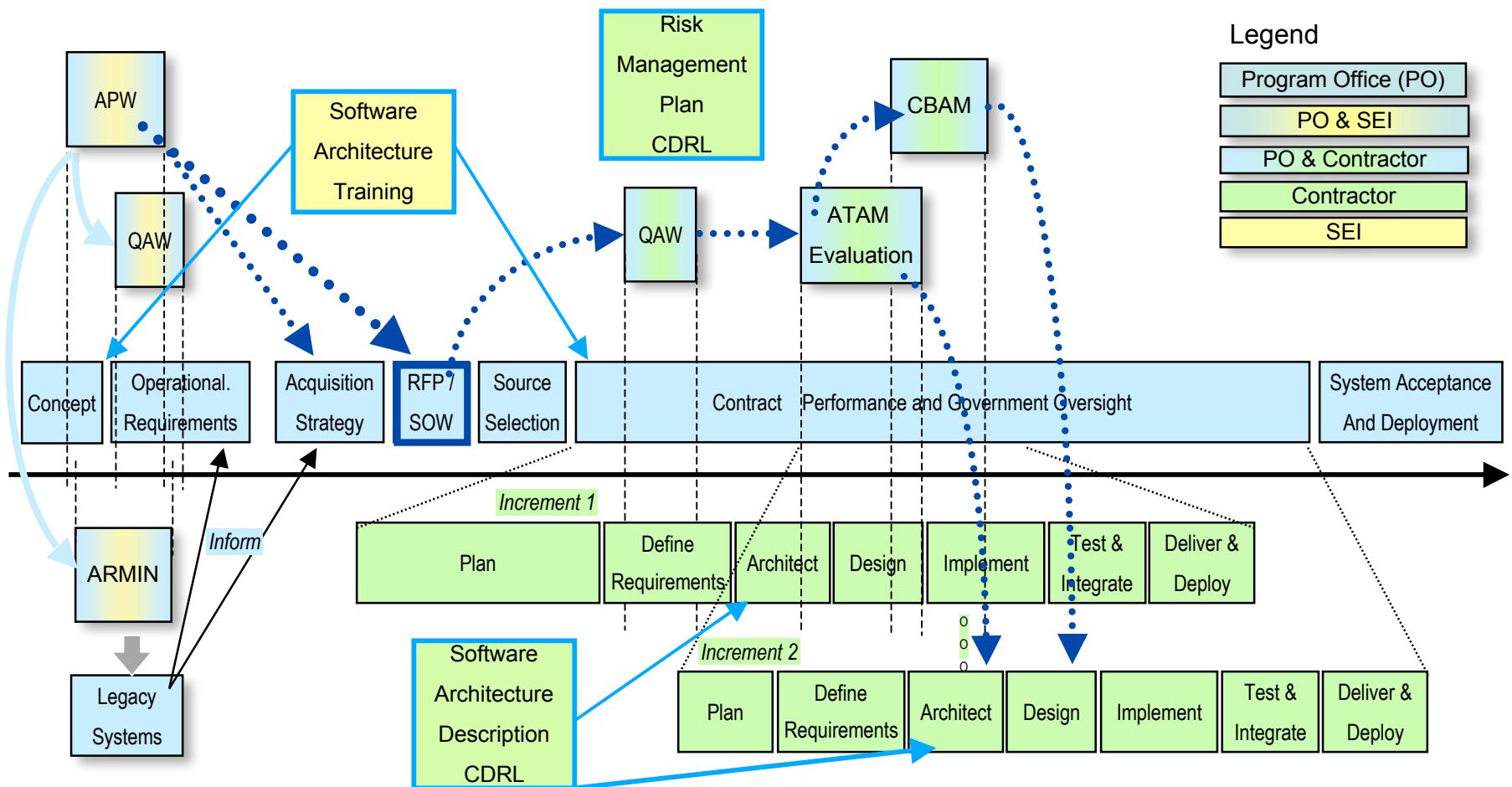
Lessons Learned

Cost realization of proposals – Differentiation between systems developed with an architecture-centric focus and those that were not and how that affects software estimation and productivity factors

Source selection plan – Clear description of how technical evaluation criteria will be evaluated

Number of CDRLs and which are important – Limited government resources that need to focus on 3-4 keys areas

Having a concept of a technical solution – Use of a reference architecture for the RFP

Proposal presentations – Importance of having verbal and visual information supporting the proposal via use of scenarios

Direct team focus on: risk management, architecture evaluation, interface control, measurement and analysis

Quote from former CLIP Assistant Program Manager

Mr. Thomas Ryan, the former CLIP Assistant Program Manager, was pleased with the close support the SEI has provided and with the quality and relevance of the technologies being applied to the program. "Had we not incorporated plans for addressing software architectural issues up-front, we would have been at risk of having to make major changes downstream in the program, which would substantially raise the costs for both us and the participating programs," he commented.

Mr. Ryan stated, "SEI is the best kept secret in the DoD!"

Summary

Pro-active planning at the RFP stage lays the foundation for the contract performance and monitoring phase

Cost proposals are very difficult to develop and even more difficult to provide cost realism to, so the program office needs to convey as clear and complete a picture of the acquisition, as possible, in the RFP

Identify the three or four most important items the government needs to accomplish during the acquisition and focus on them

Communication between the program office and the contractor's team needs to be continuous after contract award, like risk management, so that expectations can be set appropriately within the program, as well as for those external to the program

Questions

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